Chapter 4

Problem Set 1

Answer Keys

1. A beaker contains 100 mL water, aqueous ammonium nitrate, and a precipitate of barium phosphate.
2. Write the balanced molecular equation for the reaction between two solutions containing ions that could produce this solution.
3. Write the complete ionic equation for the reaction in part a.
4. Write the net ionic equation. (Don’t forget to include all physical states and oxidation numbers)

Answer:a. 3Ba(NO3)2 (aq) + 2(NH4)3PO4 (aq) 🡪 Ba3(PO4)2 (s) + 6NH4NO3 (aq)

b. 3Ba2+ (aq) + 6NO3- (aq) + 6NH4+ (aq) + 2PO43- (aq) 🡪 Ba3(PO4)2 (s) +

6NH4+ (aq) + 6NO3- (aq)

c. 3Ba2+ (aq) + 2PO43- (aq) 🡪 Ba3(PO4)2 (s)

1. Using solubility rules, decide whether the following ionic solids are soluble or insoluble in water. If they are soluble, indicate what ions you would expect to be present in solution.
2. AgI b. Li2SO4 c. (NH4)3PO4 d. Na2CO3 e. PbSO4

Answer: a. insoluble b. soluble, 2Li+ and SO42- c. soluble, 3NH4+ and PO43-

1. Soluble, 2Na+ and CO32- e. insoluble
2. Write the molecular equation and the net ionic equation for each of the following aqueous reactions. If no reaction occurs, write NR.
3. FeSO4 + NaCl 🡪
4. Na2CO3 + CaCl2 🡪
5. MgSO4 + NaOH 🡪
6. NiCl2 + Li2CO3 🡪
7. Mg(NO3)2 + K2SO4 🡪

Answer: a. NR

1. Na2CO3 (aq) + CaCl2 (aq) 🡪 2NaCl (aq) + CaCO3 (s) ;

Net: CO32- (aq) + Ca2+ (aq) 🡪 CaCO3 (s)

1. MgSO4 (aq) + 2NaOH (aq) 🡪 Na2SO4 (aq) + Mg(OH)2 (s)

Net: Mg2+ (aq) + 2OH- (aq) 🡪 Mg(OH)2 (s)

1. NiCl2 (aq) + Li2CO3 (aq) 🡪 2LiCl (aq) + NiCO3 (s)

Net: Ni2+ (aq) + CO32- (aq) 🡪 NiCO3 (s)

1. NR
2. Classify each of the following as a strong or weak acid or base
3. HF b. HClO4 c. NH3 d. HNO2 e. HBrO f. HCNO g. Ca(OH)2

Answer: a. weak acid, b. strong acid, c. weak base d. weak acid e. weak acid

1. Weak acid g. strong base
2. Obtain the oxidation number for the element noted in each of the following.
3. Ga in GaPO4 b. Nb in Nb2O5 c. Br in KBrO3 d. Hg in Hg2Cl2

e. O in H2O2 f. H in CaH2 g. O in OF2 h. N in NH2-1

Answer: a. 3+ b. 5+ c. 5+ d. 1+ e. 1+ f. 1- g. 2+ h. 3-

1. In the following reactions, label the oxidizing agent and the reducing agent.
2. P4 (s) + 5O2 (g) 🡪 P4O10 (s)
3. Co (s) + Cl2 (g) 🡪 CoCl2 (s)
4. 8Fe (s) + S8 (s) 🡪 8FeS (s)
5. CO2 (g) + C (s) 🡪 2CO (g)

Answer:

P4 (s) + 5O2 (g) 🡪 P4O10 (s)

RA OA

Co (s) + Cl2 (g) 🡪 CoCl2 (s)

RA OA

8Fe (s) + S8 (s) 🡪 8FeS (s)

RA OA

CO2 (g) + C (s) 🡪 2CO (g)

OA RA

1. Classify each of the following reactions as a combination reaction, decomposition reaction, displacement reaction (metathesis) or neutralization reaction.
2. When they are heated, ammonium dichromate crystals (NH4)2Cr2O7, decompose to give nitrogen, water vapor, and solid chromium (III) oxide.
3. When gaseous ammonium, NH3, reacts with hydrogen chloride gas, fine crystals of ammonium chloride are formed.
4. When aqueous ammonium nitrate, NH4NO2, is heated, it gives nitrogen and water vapor.
5. Aluminum added to an aqueous solution of sulfuric acid, H2SO4, forms a solution of aluminum sulfate. Hydrogen gas is released.
6. Sodium hydroxide reacts with acetic acid, CH3COOH, forms sodium acetate and water.

Answer: a. decomposition, b. combination c. decomposition d. displacement (or metathesis) e. displacement (or metathesis)